LIFETIME OF FLUORESCENCE BY AN ELECTRONIC METHOD

BY
ROBERT DOUGLAS RAWCLIFFE
B.A., North Central College, 1937
M.S., University of Illinois, 1939

AN ABSTRACT OF A THESIS
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
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This research project was initiated at the suggestion of Professor G. M. Almy, and carried out under his supervision. The sweep circuit is an adaption of a similar circuit devised by Professor L. J. Haworth for his own research. He has been very helpful in solving many electronic difficulties encountered. A number of suggestions contributed by Dr. J. H. Manley have aided the work materially. Mr. H. A. Nye suggested the solution for the electrostatic field within the Kerr cell. To these, I express my gratitude.

LIFETIME FLUORESCENCE BY AN ELECTRONIC METHOD

A knowledge of the lifetimes of the excited states of molecules is important both to the physcist and to the chemist in their study of the structure of molecules. If a molecule fluoresces, the lifetime of the excited state which produces the fluorescent light can be calculated from the rate at which the light emission decays.

In the present investigation, an apparatus has been constructed which gives directly on a cathode ray tube screen a decay curve of fluorescence. Incident light from a mercury arc is interrupted by a Kerr cell or a rotating slotted disc so that "square" pulses of light enter the fluorescence cell. The fluorescent light falls on an electron multiplier tube which is connected to one pair of deflecting plates of the cathode ray tube. A sweep circuit connected to the other pair is so arranged that the electron beam is held at one side while the incident light is shining, and then sweeps linearly across the screen while the light is off, tracing the decay curve. The sweep circuit also controls the Kerr cell.

Measurements on diacetyl vapor give a mean lifetime of fluorescence of 1.47×10^{-3} sec. $\pm$ 3% as compared with 1.65×10^{-3} sec. $\pm$ 10% as reported by Almy and Anderson.[1] Measurements on solutions of diacetyl in water and in carbon disulphide give mean lifetimes of 1.0×10^{-6} sec. $\pm$ 15% and 1.9×10^{-6} sec. $\pm$ 10% respectively. For the former, Almy and Anderson reported a value of 6×10^{-5} sec. Measurements of these solutions have shown that mean lifetimes of 10^{-6} sec. are about the shortest which can be measured by the apparatus in its present form.

With modifications of this apparatus many things which depend on the rapid variations of the intensity of light can be measured. A few examples are, the absorption lifetimes of molecules or of atoms, discharge phenomenon, and chemiluminescence.

Bibliography

1. Jour. Chem. Phys. *8*, 805, (1940).

VITA

Robert Douglas Rawcliffe was born July 27, 1913 in Cicero, Illinois. After attending the public schools of Cicero and of Downers Grove, Illinois, he went to North Central College at Naperville, Illinois, where he received the degree of Bachelor of Arts in 1937. In 1939 he received the degree of Master of Science from the University of Illinois. From 1937 to 1941 he has been a part time assistant in Physics at the University of Illinois. In 1940-41, he has also been a Fellow in Physics.